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REGULAR ARTICLE

"Generalized Darwinism" and the quest for an evolutionary theory of policy-making

Christian Schubert

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Abstract According to the "Generalized Darwinism" movement (GD), the three principles of variation, selection and retention/replication (labeled "Darwinian" in some variants of GD) can and should be used as a meta-theoretical framework for the explanation of evolutionary processes in the sociocultural domain. Despite their biological origins, the various variants of GD aim at redefining these principles in a way that is supposed to abstract from any domain-specific particulars. We argue that in order to qualify as an adequate meta-theoretical framework for evolutionary economics, GD should not only inspire and guide positive theory development in evolutionary economics, but also be able to support viable practical policy implications. Examining its potential to do so, however, leads us to the conclusion that in its specific deductive variant proposed by Hodgson & Knudsen (HKGD), it risks systematically misguiding evolutionary policy advice. Competing variants, such as the one proposed by Pelikan, fare better in this regard.

Keywords Evolution · Selection · Darwinism · Ontology · Continuity hypothesis · Evolutionary theory of policy-making

JEL Classification A1 · B4 · B52 · D6 · O1

C. Schubert (✉)
Brandenburg University of Technology,
P.O. Box 101 344, 03013 Cottbus, Germany
e-mail: c.schubert@tu-cottbus.de

"We study the laws of 'rest' in order to understand the laws of change."
(Lionel Robbins 1935: 103)

1 Introduction

The explanatory potential of metaphors and analogies from evolutionary biology (as opposed to classical mechanics) has fascinated economists since the days of Marshall and Veblen.[1] For if we wish to understand, with Lord Robbins, the "laws of change", why take the detour via the "laws of rest"? It may be more promising to tackle the laws of change directly! While the project of constructing a genuinely *evolutionary* approach to economic theorizing had been marginalized during most of the 20th century, interest in this endeavor has increased again over the last three decades or so. As a consequence, a century-old methodological debate has been rekindled about whether it makes sense to build such an approach upon concepts borrowed from Darwinian biology. In joint work with several co-authors, notably Thorbjørn Knudsen, Geoffrey Hodgson has recently proposed a meta-theoretical framework for describing and analyzing economic change along the lines of a generalization of the basic "Darwinian" notions of variation, selection and replication (or inheritance) to the socio-economic sphere (Hodgson 2002; Hodgson and Knudsen 2006a, 2010a; Aldrich et al. 2008).[2] This new framework is referred to as "Generalized Darwinism" (henceforth GD or, more specifically, HKGD).[3]

This approach reaches well beyond earlier attempts to examine the metaphorical usefulness of "evolution" or "Darwinism" in general and of these three Darwinian principles in particular to understand specific processes of socio-cultural and particularly economic evolution[4] (see, e.g., Campbell 1965; Winter 1964; Nelson and Winter 1982).[5] Given its far-ranging implications for the role of Darwinian thought in reshaping economics, for the way "evolution"

[1]I am grateful to an anonymous reviewer, as well as Guido Bünstorf, Christian Cordes, Jan-Willem Stoelhorst, Paul Jakob, Ulrich Witt and seminar participants at the 2008 annual meeting of the European Association for Evolutionary Political Economy (EAEPE) in Rome for helpful comments on earlier drafts of this paper. All remaining errors and omissions are, of course, mine alone.

[2]See also Hodgson (2010), Hodgson and Knudsen (2008b), Metcalfe (1998), Vanberg (2006), Stoelhorst (2008a, b), and in particular Hodgson and Knudsen (2010a).

[3]"Hodgson & Knudsen's Generalized Darwinism", in order to mark the difference to a competing variant (viz., Pavel Pelikan's) that will be discussed below. As Hodgson and several coauthors explain (Aldrich et al. 2008, FN 3), the originally favored notion of "Universal Darwinism" (apparently first coined, in a strictly biological context, by Dawkins 1983) has now been abandoned since it "may misleadingly suggest that Darwinism covers everything." Rather, Darwinian principles are now taken to "apply to complex population systems only" (ibid.).

[4]For the sake of simplicity, the predicates "socio-cultural", "cultural", "socioeconomic", and will be used interchangeably in the following.

[5]The underlying general motivation remains the same, however. Following Nelson and Winter (1982: 11), Hodgson and Knudsen (2007: 358) state to be "prepared to exploit any appropriate idea from biology that helps us to explain socio-economic reality".

is conceptualized in the socio-cultural arena, and for the specification of the essentials of evolutionary economics proper, it is not surprising that this new, much more ambitious program has provoked a lively debate, during which it has met with persistent skepticism (Witt 2003a; Nelson 2006; Cordes 2006, 2009; Vromen 2007, 2008, 2010; Pelikan 2011; Levit et al. 2011; Andersson 2011).[6] While some of the critics suggest an alternative variant of GD that, among other things, replaces the concept of "replication" with the more general notion of "retention" (e.g. Pelikan 2011, referring to Campbell 1965), others subscribe to a rivaling conceptual framework that they refer to as the "Continuity Hypothesis" (Witt 1999, 2003a). While the controversy continues, with all parties adducing ontological as well as pragmatic arguments and claiming the support of the founding fathers of evolutionary economics for their respective positions,[7] the time has come to probe the scientific potential of this new meta-theoretical framework to evolutionary economics. So far, this has been done in particular in the realm of industrial and firm change (see, e.g., Buenstorf 2006; Murmann 2003) and organizational change (e.g. Stoelhorst 2009; Breslin 2011).

The present paper contributes to the literature by examining whether the GD framework—specifically in the variant proposed by Hodgson & Knudsen—can support an evolutionary theory of *policy-making*. To our knowledge, it is the first to do so.[8] We argue that in order to maintain its ambition to provide a "unified evolutionary framework for the social and behavioural sciences" (Hodgson and Knudsen 2010a: 3), HKGD should also be able to direct research in that—more applied—area. At least, it should not hinder it by providing it with inadequate concepts of positive fact, which could misguide scientists' discussion of alternative policy goals and normative criteria.

General interest in an evolutionary account of policy-making has increased in recent years (see, e.g., Rubin 2002; Pelikan 2003; Witt 2003b; Wilson and Gowdy 2010; Schubert 2012).[9] First and foremost, it is expected to enable the field to enhance its practical relevance by developing sound policy recommendations. For instance, Wilson and Gowdy (2010) argue that the

[6]See also Rosenberg (2000). The debate is, however, plagued by many mutual misunderstandings, perhaps best illustrated by the exchange between Cordes (2007b) and Hodgson (2007).

[7]It is specifically the orientation of Veblen and (the late, "evolutionary") Hayek that is hotly contested (Cordes 2007a; Marciano 2009; Hodgson 2005), while Schumpeter's aversion against the use of Darwinian notions in economics is widely acknowledged (Hodgson 1997; Andersen 2009: 382). Hodgson (2005) presents some intellectual predecessors of contemporary Generalized Darwinism.

[8]Pelikan (2011: 361–363) offers two practical policy implications from his specific variant of GD, but does not discuss the potential of GD approaches in general to develop such implications.

[9]As the application of Darwinian concepts to the economic domain has now started to permeate even popular narratives of the recent financial crisis and of the evolution of financial markets more general (e.g. Ferguson 2008, stating that "[f]inancial history is essentially the result of institutional mutation and natural selection" [ibid.: 342, 350]), it seems more important than ever to check whether and how Darwinian concepts distort the development of policy advice.

economic approach to policy-making should be informed by evolutionary theorizing, for the latter can improve policy advice by helping decision-makers "understand the large-scale and long-run consequences of economic policies" (ibid.: 5; see also Pelikan 2003). Second, an evolutionary perspective could support and lend theoretical substance to the intuitively appealing method of information gathering that is commonly referred to as "trial-and-error" and that is particularly apt at solving many complex policy problems (e.g. Pelikan 1995; Harford 2011). Third, an evolutionary perspective could make sense of issues that are misconceived in neoclassical accounts of policy-making, such as the complex relationship between individual and collective welfare, and the persistence of mal-adapted ("irrational") products of evolutionary processes, such as dysfunctional institutions (Whitman 1998).

In general, a proper evolutionary theory of policy-making should be based upon three pillars: It would need to (i) explain how the process of policy-making factually works, and how political institutions change over time, (ii) probe the effectiveness of alternative policy instruments (including general problem-solving mechanisms such as trial-and-error) under the conditions of an evolving economy, and (iii) discuss the legitimacy, applicability and operationalization of the diverse goals and criteria of policy-making (Keynes 1917; Witt 2003b). While it seems that pillars I and II can quite easily be construed within an evolutionary framework,[10] the third, genuinely normative pillar is much more challenging and controversial (and, unsurprisingly, largely neglected in the evolutionary economics literature). Its crucial role for the development of sound policy advice has, e.g., been stressed by Nelson (1977, 1981).[11] To illustrate, consider the issue of whether standard normative concepts such as Pareto efficiency or "market failure" can be consistently applied in an evolutionary setting. This leads us to the first of two hypotheses:

(**1**) An evolutionary approach to policy-making requires a sound "normative structure" (Nelson 1977: 18) in order to examine and clarify which policy goals and criteria can be consistently applied in an evolutionary setting of changing and incoherent preferences.

Given hypothesis 1, we ask whether such a "normative structure" can be construed within an evolutionary economics *that is conceptualized in terms of Generalized Darwinism*. As we will see, our second hypothesis can be defended:

(**2**) At least in the variant proposed by Hodgson & Knudsen (HKGD) the Generalized Darwinism framework risks misguiding the construction of

[10] On the first pillar see, e.g., Ebner (2006), Wohlgemuth (2002). On the second pillar, see, e.g. Kerstenetzky (2000, 2007), Dolfsma (2005), and Witt (2003a).

[11] See also Nelson and Winter (1982: ch. 15), Dopfer (1976: 19–29), Witt (1996a), Hodgson (1999: ch. 11), Schubert (2012).

a normative structure within an evolutionary theory of policy-making; it does so, not by systematically favoring a specific ideology (say, laissez-faire, or conservatism),[12] but at a more fundamental level, by smuggling in unjustified preconceptions into the process of normative reasoning, thereby lowering its quality.

We submit that it is ultimately the deductive, *top-down* methodology of HKGD that makes it ill-equipped to deal with the specific normative challenges brought about in an evolutionary world. Since other variants (in particular Pelikan's) do not share this particular feature, our critique does not necessarily apply to them.

The paper is organized as follows: In Section 2, we reconstruct the position held by the GD movement, as it has been specified until now. Section 3 briefly presents the main objections against this approach, as well as the main alternatives offered, all within a purely positive research agenda. Section 4 then focuses more specifically on the difficulty to think about policy-making, policy implications, and welfare in an evolutionary framework, inferring the need to stick either to a modified variant of GD or to a non-Darwinian framework in order to cope with the issues involved. Finally, Section 5 concludes.

2 "Generalized Darwinism": a roadmap

2.1 Basic commitments

The GD proposed by Hodgson, Knudsen and co-authors is apparently influenced by evolutionary theorists such as Campbell (1960, 1965), Dawkins (1983), Lewontin (1985), Dennett (1994), and in particular Hull (1988).[13] On a most basic methodological level, GD claims the following:

(**1**) All social science should be committed to "detailed, cumulative, causal explanations" rather than functional "just so-stories".[14]

(**2**) A specific causal-explanatory logic applies to all evolutionary processes: All such processes in both the natural and the socio-cultural realm

(**2a**) share the *same* basic ontological structure,

[12] We also do not argue that the use of biologically inspired concepts necessarily implies a "Panglossian" outlook on the economy. There is no mechanism in biological evolution guaranteeing that only "optimal" results will prevail (Whitman 1998: 49–55).

[13] See in particular Hodgson and Knudsen (2006a, 2008b), Aldrich et al. (2008), Hodgson (2002).

[14] Hodgson (2002: 260, 268–269). See Vromen (1995: ch. 5) for a subtle methodological critique of the inadequate functionalism involved in "just-so stories".

(**2b**) which is, more specifically, one that can *only* be described by the "Darwinian" scheme of a dynamic interplay of variation, selection and replication (or inheritance). In terms of heuristics, the Darwinian scheme is the only framework that can be used to model these processes.[15]

When talking about "evolutionary processes", Hodgson and coauthors focus on phenomena of "complex (evolving and replicating) systems", involving populations of heterogeneous entities that causally interact with each other. Systems of this kind in both nature and culture are taken to exhibit a common ontological basis, viz., one that is characterized by the properties of variation, selection and inheritance. Any system where these properties are present and interact dynamically is said to display "Darwinian" evolution. Hence, the latter is argued to actually *occur* in both systems: Both natural and socio-economic evolution *are* Darwinian in key respects.[16] In other words, Darwinian processes are identified as generic algorithms that are substrate-neutral. Defining Darwinism—quite broadly—as a "causal theory of evolution in complex population systems involving the inheritance of generative instructions by individual units and a process of selection of the varied population of such entities" (Hodgson and Knudsen 2006a: 13), they insist that any attempt to explain such systems in both nature and society must *necessarily* rely on these three "core Darwinian principles" (ibid.).[17] Put differently, natural selection is the *only* mechanism working in complex population systems.

Hodgson and Knudsen (2006a) define their object of study as "complex systems", involving populations of "entities of specific types" that are heterogeneous in "relevant respects." These entities absorb both matter and energy and are able to process information about their environment. Being "mortal and degradable" and confronted with the "omnipresent problem of local and immediate scarcity", they are engaged in a perpetual "struggle for existence" (Aldrich et al. 2008: 583).[18] Importantly, the entities are also assumed to possess some capacity to "retain and pass on to others workable solutions to problems" they face in the course of their daily struggle (ibid.). Defined in such an extremely abstract way, Hodgson & Knudsen's entities are argued to

[15] As we will see below, the variant of GD suggested by Pelikan (2011) differs from HKGD in several ways: For instance, it disagrees with HKGD about what exactly the "Darwinian" principles are: specifically, it skips "replication" in favor of the much more general notion "retention"; it also does not claim that GD is the "only" way to understand economic change (ibid.: 344). Pelikan (2012) clarifies the differences between his variant of GD and Hodgson & Knudsen's. See also Sections 3.3 and 4.6, below, for further discussion.

[16] The facts that (a) Darwin, when establishing his principles, was influenced by social philosophers such as Malthus, and that (b) Darwin himself speculated about the evolutionary forces transforming morals and language are cited in support of this hypothesis; see, e.g., Hodgson (2007: 265). Ironically, fact (a) is also put forward by opponents of GD in support of *their* position (see below).

[17] See also Hodgson (2010: 10).

[18] Italicized in the original.

include not only "every biological species", but also "human institutions" and business firms (ibid.: 4–5).

As Hodgson et al. hasten to add, Darwin's abstract principles[19] have to be complemented by (yet largely to be developed) domain-specific auxiliary theories and hypotheses in order to get a satisfactory explanatory account. Since they emphatically reject any genetic reductionism,[20] advocates of HKGD have to acknowledge that on a less abstract level the mechanisms and processes of change are "very different" both within and between different types of (natural and socio-cultural) systems. The concepts themselves are thought to serve as heuristics that guide and structure further theory development in the realm of socio-cultural change. Thus, HKGD contains not only ontological presuppositions, but also heuristic precepts and, hence, the contours of an ambitious research program.

In order to justify the claim that the three Darwinian principles are necessary to explain the way such complex systems evolve over time, Aldrich et al. (2008: 583–584) set out to define three core explananda that any theory of evolution should be able to confront. According to HKGD, then, such a theory must necessarily include an account of

(i) how variety occurs,
(ii) how "useful information concerning solutions to particular adaptive problems"—which may be carried, e.g., by social norms or business firm routines—"is retained and passed on" or "copied",
and finally and most importantly
(iii) an account of the "fact that entities differ in their longevity and fecundity".

As regards the last point, it is argued that only the *principle of selection* can explain why some entities or units are more successful (in terms of survival or imitation rates) than others. This principle is regarded as the prime legacy of Darwinism for the general explanation of evolutionary processes that manage to generate "adaptive complexity" (Stoelhorst 2008a). According to Hodgson and Knudsen (2006a: 6), selection is about how new variations are "tested in the real world". The explanation is then based on the attempt to trace changing frequencies of posterior entities to their properties in some given environmental context.

[19]Strictly speaking, these are not "Darwin's" principles. Darwin's own account of evolution actually consists of five theories (Mayr 2001), viz., a theory that organisms are transformed over time, the theory of common descent, plus the (originally more disputed) theories of multiplication of species, gradualism and natural selection proper. See Levit et al. (2011) for further details. The reduction of Darwin's theories to the three "core principles" of variation, selection and retention/inheritance ("mechanisms for preserving and/or propagating the selected variations") is due to Campbell, cf. e.g. Campbell (1965).

[20]See, e.g., Aldrich et al. (2008) and Hodgson (2002: 270–276). According to Hodgson, Darwinism is committed to "determinism" in one of three possible senses, viz., the ontological assumption that "every event has a cause" (ibid.).

2.2 The importance of selection

The bulk of the argument in favor of HKGD is based on the rejection of the "selforganization" theory which Hodgson (2002: 264–266) identifies as the most prominent rival to his own approach when it comes to providing a general account of "evolution" (see also Hodgson and Knudsen 2010a: 51–57). According to Hodgson, self-organization is successful in explaining how undesigned social order emerges, but it is not sufficient to explain the "origin of species and of all complex biological phenomena" more general. Interestingly, in order to substantiate this point, Hodgson and Knudsen (2006a) argue that *within biology*, proponents of self-organization such as Kauffman (1993) do actually not see this approach as an "alternative to natural selection" (Hodgson and Knudsen 2006a: 7). For without selection, so the argument goes, it is impossible to explain the "move toward the emergence of *increasingly complex* structures" (ibid., italics added). Only an explanation using the principle of selection can show why a subset of self-organized units acquire "survival value" by gradually becoming adapted to their environment.[21]

According to Hodgson & Knudsen (ibid.: 8), an approach focusing on self-organization, by concentrating on the way some given entity develops "internally", neglects both the way this entity itself has come about (as a result of some antecedent process of selection) as well as the interactions of the entity with its environment and the resulting process of adaptation. Put differently, self-organization theories are said to focus exclusively on the ontogeny of single organisms or "structures" such as firms. By contrast, HKGD is argued to also account for phylogenetic processes that involve the evolution of a whole population of entities within which selection occurs. Phylogeny denotes a more general process in that it necessarily also incorporates ontogenetic processes at a lower level (see also ibid.: 10).

At this point, the meaning of "selection" deserves some closer scrutiny. First and foremost, Hodgson and Knudsen differentiate between subset selection—i.e. selection by partial elimination (a firm's bankruptcy, say)—and (what they call) successor selection, which involves not only adaptive change, but also the generation of genuine novelty.[22] Through the lens of HKGD, both processes of selection operate in a rich array of phenomena including "conscious choices, competitive pressures, market forces, or environmental constraints," all operating on "habits, customs, technologies, institutions, regions and even whole economies" (ibid.: 10). HKGD now proposes to generalize the notion of selection quite radically in order to allow it to include human intentionality. This problem is related to the task to come to terms with, first, "artificial selection" and, second, "Lamarckian" evolution.

[21] On this, see the detailed argument by Stoelhorst (2008a).

[22] This is inspired by Price (1995).

The American institutionalist J.R. Commons (1934) famously objected to a broad application of the notion of selection by arguing that institutional change involves *artificial* rather than "natural" selection. Artificial selection implies humans deliberately controlling the selection process by manipulating the "criteria or environment of selection".[23] The proponents of HKGD respond by redefining the notion of "selection" itself in a way sufficiently abstract to include those processes that Commons called "artificial":[24] They argue that "the human doing the selection is also a product of natural evolution"—in particular her "dispositions, aims and criteria" are to be seen as resulting from "processes of cognitive and cultural evolution" (Hodgson and Knudsen 2006a: 11). As the latter are seen as being based on the operation of "selection" proper, Commons' distinction is rejected.

The notion of selection is also explicitly redefined in a way that allows to incorporate the "Lamarckian" idea about the retention of acquired characters (Hodgson and Knudsen 2006a: 12–13). This is usually referred to as a typical feature of socio-cultural, as opposed to purely natural, evolutionary processes, since the former are also based on the purposeful change of behavioral traits by creative agents.[25] Hodgson & Knudsen now argue that, first, Darwin himself had actually accepted the possibility that acquired traits can be inherited (thus making it plausible to subsume such a phenomenon under the umbrella of "Darwinism").[26] Second, they maintain that Lamarckism cannot itself answer the tricky question why in general, *non*-beneficial acquired characters are *not* passed on to the next generation. In order to explain this, it again needs to refer to some overarching Darwinian selection process. Thus, Lamarckism is argued to be a less general account of evolution than Darwinism proper.[27] Again, in a way analogous to the argument concerning "artificial" selection, Hodgson & Knudsen argue that the human capacities involved in the Lamarckian account are to be seen as the product of an anterior process of selection: "Insofar as organisms are purposeful, this capacity too has evolved through natural selection" (ibid.: 13). Hence, they claim that Darwin's three principles "do not themselves exclude the possibility of acquired character inheritance" (ibid.).

[23] See Hodgson and Knudsen (2006a: 11).

[24] See in particular Knudsen (2004).

[25] See, however, Hodgson and Knudsen (2006b) on the pitfalls of a Lamarckian perspective on cultural evolution.

[26] It does not appear to be necessary to engage in Darwinian exegesis at this point, since the question may well be left open whether Darwin himself was a "Darwinist" in the sense of HKGD, or whether it makes sense to restrict the meaning of "Darwinism" to the state of the art of evolutionary theory before Darwin's death. After all, the conceptual and theoretical body known as Darwinism achieved its logical coherence only decades after Darwin had died in 1882. See FN 19, above.

[27] To the contrary, Pelikan (2012) sees Darwinism as a special case of Lamarckism, since the latter allows for a diverse set of feedback (learning) channels, while in Darwinism (as typically understood), this capacity for "learning from experience" is zero.

2.3 Getting practical: replicators and interactors

The final issue in the argument for Generalized Darwinism concerns the fact that on a less abstract level, there are many obvious *differences* between the phenomena and mechanisms involved in natural and socio-economic evolution. It is evident that analogues to genes, DNA, or sexual recombination are hard or even impossible to find in places such as the market, the firm, the law or the political arena. Mechanisms involved in generating variety or transmitting information are dissimilar, often extremely so. Even to the casual observer, anything akin to "selection" in the economic sphere works differently than natural selection among phenotypes (see Section 3.2, below).

From a methodological viewpoint, it is now quite revealing to see that Hodgson and Knudsen (2006a) readily acknowledge all this,[28] only to declare it perfectly *irrelevant* for their argument: HKGD is said to be "about ontological communality" rather than about "analogy or metaphor" (Hodgson 2002; Aldrich et al. 2008: 580). Hodgson and Knudsen (2006a) state that "Darwinism is more general and is not tied to these particulars" (ibid.: 14), meaning that "the transfer of Darwinian principles from biological to social evolution does not imply that the detailed mechanisms of selection, variation and inheritance are similar" (ibid.: 15).[29] Accordingly, Hodgson & Knudsen maintain to be able to neutralize any objection that points toward such differences by re-defining the Darwinian core principles in ever more abstract terms in order to strip off any domain-specific biological content (Vromen 2008). As we have seen, Darwinism in the very specific sense it is then used by HKGD is argued to accommodate Lamarckism, intentionality, "artificial selection", "selection" occurring within the life of a single socio-economic unit (such as, e.g., a learning individual or firm), and even creative choice (Hodgson 2002: 276): "As long as there is a population with imperfect inheritance of their characteristics, and not all of them have the potential to survive, then Darwinian evolution will occur" (ibid.: 270).[30] Relative to this, any observable phenomenological differences are declared irrelevant.

While these assertions certainly cannot be denied in the sphere of pure logic, this does not yet validate them from a pragmatic viewpoint. The latter is however essential, given the HKGD movement's explicitly stated purpose to use Darwinism not just as an anemic framework that is in need of additional auxiliary theories to explain any real-world phenomena of change (this is almost trivially true), but as a productive framework that is able to *inspire*, *frame* and *organize* further theory development in evolutionary economics,

[28] See also, e.g., Hodgson and Knudsen (2008a: 49): "Nothing in social culture remotely corresponds to the DNA code".

[29] See also Hodgson (2007: 270), Aldrich et al. (2008: 580) and Stoelhorst (2008a: 354).

[30] See also Hodgson and Knudsen (2006a: 16).

i.e., to provide constructive heuristics for future research on a less abstract, applied level.[31]

Can the Darwinian triple of variation, selection and replication effectively inspire, frame and organize theory development? As we will see shortly, this is in fact the key issue in the debate about GD. In order to demonstrate the practical potential of their particular brand of GD, Hodgson and Knudsen leave the abstract heights of ontology in order to apply HKGD to real-world explananda, specifically in the realm of market competition, firm growth and industry evolution. In order to obtain operational units of analysis, they generalize the biological concepts of genotype and phenotype and borrow the notions of *replicator* and *interactor* (Aldrich et al. 2008: 586–588).

Replicators and interactors are said to play a role in both biological and economic evolving systems. In particular, they are meant to also capture the phenomenon of Lamarckian evolution, with traits being "encoded in an instruction set that is passed on to the next generation" (Hodgson and Knudsen 2007: 356). Such an instruction set is called a "replicator". Hull (1988: 408) defines this term as "an entity that passes on its structure largely intact in successive replications".[32] Put differently, it is "an information-retaining and copiable mechanism" (Hodgson and Knudsen 2012b). Replication is argued to capture the transmission of information in evolving systems. A replicator, then, denotes any mechanism that carries instructions which can be passed on to the next generation of entities by some form of more or less faithful copying or reproduction. By contrast, an interactor is an entity that "interacts as a cohesive whole with its environment in such a way that this interaction causes replication to be differential" (ibid.).[33] These entities "host" replicators; they manifestly *express* the replicating information.

In the biological domain, paradigmatic examples for these two kinds of entities are genes (as replicators) and individual organisms (as interactors). According to Hull (1988: 409–410), "selection" can then be characterized as involving the interplay of both replicators and interactors in such a way that the differential success of interactors causes differential survival on the part of the relevant replicators. Lamarckism would then imply that the instruction set contained in the replicator is modified in the course of the interactor's

[31] See Hodgson and Knudsen (2006a: 16) and Hodgson (2010: 13): "[Generalized Darwinism] can ... have an important impact on the development of middle-range theory and serve as a useful guide for empirical enquiry."

[32] See Hodgson and Knudsen (2010b: 15) for three features that characterize a replicator, namely, "causal implication", "similarity" and "information transfer". Earlier, Dawkins (1976) had described replicators as being characterized by their "longevity, fecundity and copying-fidelity"; cf. also Hull (1989: 95–98) and Hodgson and Knudsen (2008a) for a detailed discussion of the term's semantic history. Importantly, there are simple processes of adaptive change (viz., subset selection) that do not involve replication of any kind. As a consequence, they *a fortiori* do not have the potential to increase complexity (Hodgson and Knudsen 2012b).

[33] Italics in the original.

adaptation to its environmental conditions. It is then transmitted only after this modification has taken place. Thus, we have the first important heuristic following from HKGD: When studying socio-economic phenomena, watch out for replicators and interactors!

According to Hodgson and Knudsen (2004), in the economic domain habits and routines can usefully be modeled as replicators, with firms playing the role of interactors. While they do not follow Nelson and Winter's (1982) notorious suggestion that routines of firms can be described as analogs to genes, they do nonetheless see a similarity in the sense that both genes and routines are replicators. Thereby they suggest that it is the more or less faithful copying ("inheritance") that characterizes these entities.[34] Apart from business firms and single individuals, HKGD also interprets "social groups or institutions" as interactors (ibid.).

An important final step in the theoretical argument for HKGD is the attempt to explain the emergence of *complexity*. Hodgson and Knudsen (2010b) argue that a special subset of replicators that they call *generative* replicators are able to increase complexity in any evolving system. This type of replicators transmits information that crucially also contains developmental (program-like) instructions, i.e., a "construction mechanism that can create a new entity on the basis of a fairly simple set of instructions" (ibid.: 13). Defining complexity of an evolving entity as the "amount of information that it stores, about the environment in which it evolves", they show that the capacity to enhance complexity depends critically on the condition that copy errors (as opposed to mere "reading errors") are sufficiently infrequent (ibid., 20). As a paradigm example of such super-faithful copying they mention Intel's strategy to set up new plants by establishing exact copies of the older units (ibid., see also University of Hertfordshire 2010).

3 ...But how far does it lead us?

This Section presents the main objections against applying the framework, suggested by HKGD, to processes of socio-cultural evolution. It then discusses competing meta-theoretical approaches.

3.1 Room for agreement

Given that this is a meta-theoretical approach, how can we tell whether it is useful and adequate? HKGD involves a rather complex set of presuppositions

[34]The analysis gets more complicated, though, when it is acknowledged that what may emerge as an interactor at one level of phenomena might act as a replicator at another level: "Human individuals can be seen as interactors (with their genotypes as replicators), but individual preferences or ideas can be regarded as replicators at a higher level of cultural transmission" (Hodgson and Knudsen 2008a: 49).

and definitions. It may be useful to distinguish between three levels, in decreasing order of abstractness:

(i) The level of fundamental metaphysical[35] and meta-theoretical propositions (such as the pledge to ontological monism and causal explanations);
(ii) The level of suggested (re-)definitions of the terms "variation", "selection" and "replication";
(iii) and, finally, the more applied level concerning, e.g., the suggested use of the concepts of "replicator" and "interactor".

Obviously, the statements that we find at levels (i) and (ii) can neither be proven by logic nor falsified by empirical evidence. Nonetheless, most of the recent "defences" of HKGD's proponents against their critics seem to be motivated by the wish to articulate and justify, over and over again, the belief in the propositions covered by (i) and the logical possibility to define and re-define, in an internally consistent way, notions as suggested in (ii).

In itself, this is fruitless. The only relevant issue in our context is whether it makes sense to jump from the combination of (i) and (ii) to those statements that we find at level (iii). It is this jump from the abstract heights of ontology and notional exercises down to the level of operational units of analysis that will be discussed in this section. Put differently, the debate on HKGD should be about the usefulness of generalizations and metaphors in framing the perception of explananda and in guiding and structuring further theory development and policy applications in evolutionary economics. As Hodgson (2002: 263) puts it, "[m]etaphor in general has a deeply constitutive and subterranean presence in science … by helping to form analogies, the influence of metaphor is neither superficial nor merely preliminary".[36]

Let's look at level (i), first. HKGD's most fundamental precommitments are rarely contested by evolutionary economists, including those that tend to oppose HKGD on other grounds. First and most importantly, both camps agree upon the basic assumption that there is indeed a need for an abstract, i.e., domain-unspecific concept of "evolution".[37] Second, there is a broad consensus regarding the general "Darwinian world-view", epitomized by a "naturalistic" belief in ontological monism (see HKGD's claim 2a, Section 2, above), i.e., the assumption that "both change in the economy and change in nature belong to connected spheres of reality" (Witt 2008b). Note that in this context, the adjective "Darwinian" has a semantic content that is much more general than in the parlance of HKGD. Related to this abstract concept of "Darwinism", any reductionist monism is widely rejected (Witt 2008a; Hodgson and Knudsen 2006a). Third, there is agreement about the

[35] On the criteria qualifying statements as "metaphysical", cf. Popper (1989: ch. 11).

[36] This fundamental insight seems to be neglected by Geisendorf (2009) who, in an attempt to defend GD against some of its critics, downplays the importance of concrete "vocabulary" such as "selection" (ibid.: 380, 386).

[37] See, e.g., Hodgson (2010: 12–13) and Witt (2008b).

separate[38] ontological postulate that there is a general *causal* link between all levels and parts of empirical reality, in particular between the spheres of non-human nature and man-made culture. Accordingly, both camps share the methodological emphasis on the search for commonalities at the level of homomorphic structures of reality,[39] coupled with a focus on causal (rather than functional) explanations (HKGD's claim 1, Section 2, above).

The argument starts, however, with HKGD's assertion that processes of natural and sociocultural evolution share a very specific ontological structure, viz., one that allows and prescribes the application of "Darwin's principles" in order to be explainable (HKGD's claim 2b, Section 2, above, which is related to level (ii)). This very specific position directly implies a certain stance on the heuristic level, i.e., on how theoretical problems should be framed and understood to generate meaningful hypotheses. As we will see shortly, the particular ontological position underlying this heuristic stance does not necessarily follow from a general commitment to ontological monism. In other words, a monistic ontology can be more complex in order to allow for a subtle, yet clear distinction between the realm of pure biological and socio-cultural evolution.

3.2 Objections against HKGD

Given the fact that there is by now a rich literature on the pros and cons of using Generalized Darwinism (in particular its HKGD variant) for positive theory development, we will restrict our discussion to a brief recapitulation of the key objections that have been leveled against it.

- The most important and most straightforward objection against all attempts, including HKGD's, to transfer concepts from biology to economics concerns the problem of slipping into the use of *analogies*. Proponents of HKGD do not deny that uncritical analogical reasoning may lead theory development seriously astray. To be sure, there is a categorical difference between analogy and generalization, and the latter does not, *per se*, imply the former.[40] Nevertheless, if the generalization leads to abstract principles

[38] See Vromen (2008) on the differences and the basic independence between these ontological precepts.

[39] See Witt (1996b: 709). This is based on the methodological meta-project of "Consilience", suggested by Wilson (1998), where he defines the related quest for a "unity of knowledge" as implying the "'jumping together' of knowledge by the linking of facts and fact-based theory across disciplines to create a common groundwork of explanation."

[40] As Hodgson (2007: 269) aptly defines these terms, *analogy* refers to taking "one phenomenon or process ... as the reference point and other similar processes are compared to it," while *generalization* "starts from an array of different phenomena and processes, without giving analytical priority to any of them over others. Where possible, shared principles are adduced ... These common principles will not reflect detailed mechanisms found in any one particular domain." See also Aldrich et al. (2008: 579–580).

that are supposed to play a productive heuristic role (which implies that they are not so abstract as to be effectively void), then we cannot exclude *a priori* the risk that the *practical use* of these abstract principles may systematically induce the scientist to end up, perhaps inadvertently, with analogical reasoning. The line separating generalization and analogy, so clear-cut in theory, may become blurred in scientific practice. While this practical risk is consistently neglected by Hodgson, Knudsen and the other proponents of HKGD, it is what worries their critics the most.

Why are analogies from biology misleading?[41] To illustrate, consider "variation". In nature, it can safely be assumed to be "blind" in the sense of "perfectly pre-programmed". This holds not only for undirected genetic mutation, but also for the more important recombination of genetically coded information (cross-over) which uses "background knowledge" of past successful adaptations. By contrast, in the cultural realm, variation is hardly ever "blind" *in this particular sense*. Humans act on knowledge they have acquired and choose strategies accordingly - in this sense, their choice behavior is always informed, if imperfectly so. Based on their subjective beliefs, humans recombine given elements in a way that is much more directed than is the case in genetic cross-over: "In cultural evolution in general, and in economic evolution in particular, the causes of novelty generation are not independent of the wants and longings of individuals" (Witt and Cordes 2007: 325). The fact that on an aggregate level, the results of human interaction can still never be predicted with certainty does not render micro-level "variation" any "blinder".[42] More importantly, it may be argued that it is precisely *within this difference in the degree of "blindness"* that most interesting research questions of evolutionary economists are located: Why and how do individual beliefs and attitudes change? Hence, biological variation and cultural "variation" differ in essential respects, and these differences are highly relevant in terms of the research agenda of evolutionary economics. Similar reasoning applies to the principles

[41]Note that analogies *from economics* played a key role in the early days of Darwinism: Browne (2006: 43, 44, 56, 67), for instance, stresses the influence of Malthus, industrial analogies and the specifically Victorian entrepreneurial spirit on Darwin's thought. As Marx put it in a letter to Engels, "[i]t is remarkable how Darwin recognizes among beasts and plants his English society, with its division of labour, competition, opening up of new markets, 'inventions', and the Malthusian struggle for existence" (cited in Guha 1994, endnote 1). See also Ghiselin (1995) and Marciano (2009).

[42]There are two different meanings of "blind": Following evolutionary epistemologists (such as Campbell 1987), Vanberg (2006: 202) argues that human behavior is "blind" in the sense that in an evolving economy, humans cannot *predict* with certainty whether their "conjectural trials" will finally be successful. This is uncontroversial. The lack of predictability concerns, however, the level of aggregate results of individual actions (the "social order" resulting from one or many interpersonal interactions), not the level of the grounds of individual action itself (which, even when it follows rules, is never "blind" in the sense of "being perfectly pre-programmed").

of "selection" and "replication" (see, e.g., Cordes 2007a: 140, Witt 2001: 138–39, and Nooteboom 2008).

- As we have seen, Hodgson et al. attempt to neutralize this objection on methodological grounds: They claim that *because* of the possibility of generalization, any criticism pointing toward real-world differences between the biological and the cultural domain is simply "irrelevant" (Hodgson 2007; Aldrich et al. 2008: 580): "[T]he idea of generalizing Darwinism has little to do with biological metaphors or analogies" (Hodgson and Knudsen 2010a: 22).

Or has it? No one denies the intellectual possibility of defining and redefining notions such as variation, selection and replication in a perfectly abstract, trans-disciplinary space, such that any of the phenomena described above are covered, however loosely. There is an obvious risk involved, though: As Aldrich et al. (2008: 588) concede, "generalization should not go as far as to become vacuous" (see also Vromen 2007: 19–21). So far, the jury is still out on whether it is in fact possible to descent from the abstract heights of ontology without, on the way, slipping into (crypto-)analogical reasoning that risks biasing economic theorizing. As for instance Buenstorf (2006) and Nooteboom (2008) demonstrate, this risk is real.[43]

Tellingly, advocates of HKGD hold Darwin's principles to be suitable for generalization beyond the domain of biology exactly because variation, selection and replication operate in different ways also *within nature*. In particular, they may also involve intentionality, sometimes even relatively rapid change. Quoting Darwin himself, they emphasize, e.g., that "animals possess some power of reasoning. Animals may constantly be seen to pause, deliberate and resolve."[44] As to the issue of evolutionary speed, they argue that "some bacteria evolve quickly, and very rapid biological replication and mutation can occur with viruses."[45] They conclude that "[t]he differences of mechanism *within* the biological world are as impressive in some ways as the differences between the biological and the social."[46]

It is, however, a non-sequitur to jump from this set of observations to the conclusion that Darwin's principles apply to cultural evolution as well. First, even if there are a lot of differences within the natural world concerning, e.g., the way selection works, this does not imply that a principle of "selection" covering these heterogeneous *natural* mechanisms can also be meaningfully applied to cover similar-looking mechanisms in the *cultural* domain.

[43] Consider Buenstorf (2006), showing that the selection concept suggested by HKGD systematically biases the perception of theoretical problems by downplaying the role of essential economic factors, such as the market exchange process between producers and consumers. It is not hard to see the potential distortionary impact of such a bias on *normative* reasoning (see Section 4, below).
[44] Cf. Hodgson and Knudsen (2008a: 60).
[45] See (ibid.: 63).
[46] See (ibid.: 64).

"Intentionality" in nature may still mean something entirely different than intentionality in human culture; the reason why bacteria and viruses evolve so fast may have nothing to do whatsoever with the reason why certain human technologies, say, evolve quite rapidly. Second, it may be much more *interesting* to enquire into the reasons why processes and mechanisms involved in observable change differ so much between the two domains. Large parts of the literature supporting HKGD are devoted to explaining the differences between, say, reproduction of haploid as opposed to diploid organisms rather than focusing on the much more relevant (to the economist) question of why exactly cultural information is "replicated" in such a markedly distinct way.

Hence, the "irrelevance hypothesis" can be returned to its senders: By trying to show that their principles are truly domain-unspecific, Hodgson et al. have emptied them "from virtually all of their content" (Vromen 2008: 19). Such a "watered-down" version of HKGD may indeed be practically irrelevant for the scientific purposes its authors have in mind.

3.3 Pelikan's variant of GD

Pavel Pelikan has recently suggested a variant of Generalized Darwinism that draws on evolutionary-developmental biology (Carroll 2005). He emphasizes the point that processes of variation, selection and retention are not necessarily "Darwinian". In particular, rather than focusing on the "replication" function of genes or their alleged correlates in the socio-economic sphere, his version of GD stresses the crucial role of instructions. Economic *development* is then conceptualized as "instructed self-organization", while *evolution* properly understood is defined as the experimental search for those instructions over time.

This version of GD differs from Hodgson & Knudsen's in three important ways: First, it has been developed in an inductive way rather than starting from some highly abstract principles (Pelikan 2011: 344; Pelikan 2012: FN 1). Second, it focuses on instructing genomes rather than replicating genes: As Pelikan (2011: 342) puts it, "much of socioeconomic change takes place without replicating".[47] Hence, he follows Campbell (1965) in describing evolutionary processes in terms of "variety, selection and *retention*" (italics added).[48] It is evolving instructions that guide, at each stage of their evolution, developmental processes. Third, Pelikan leaves room for processes that are of a developmental, rather than evolutionary nature, such as cooperation and self-organization. Pelikan (2011: 344) is also explicit in modifying the ambition of

[47] See also Pelikan (1995: 182): "We should not try to find at any price an exact social analogue to biological replicating... New institutional rules can often be tried within an existing system, while some systems—such as national economies—can hardly die and can never start from zero again."

[48] Apart from eschewing the terms "replication" and "replicator", Pelikan also denies the usefulness of the term "interactor", preferring "agent" instead (Pelikan 2012). See Hodgson and Knudsen (2012a) for a reply to Pelikan's criticism.

his variant of GD: "[G]eneralizing Darwinism is not claimed to be the only way to understand economic change". This is in marked contrast to the bold claim advanced by Hodgson & Knudsen that explanations of economic change "must" be couched in terms of their Darwinian principles.

Pelikan (2011) presents a model in which heterogeneous, intentional, learning and interacting "basic" agents (b-agents) in a given environment form a network to develop and operate a "complex" agent (C-agent). To illustrate, consider individuals who form and operate an organization.[49] Thanks to the specific network formed by its b-agents, the C-agent may be able to do things (such as conducting trial-and-error searches) that surpass the abilities of single b-agents. A C-agent may also influence the behavior of the b-agents. Its "fitness" is tested in the "moderately hospitable" environment according to some success criteria.

The distinction between evolution proper and development is made using the key concept of "instructions"[50]: "Evolution produces instructions for the development of a C-agent by guiding the self-organizing and operating of its b-agents" (ibid.: 346). Evolution is, broadly speaking, about trial-and-error searches. Its units of selection are instructions, rather than C-agents (e.g. "organisms") themselves (on this, see also Pelikan 1995: 182). In the socio-economic realm, it is institutional rules that operate as the bridge between economic evolution and development: They are the product of the former, but serve as instructions for the latter (ibid.: 358).

Pelikan has applied his approach to GD to two policy problems, viz., the development of poor economies and the issue of multiculturalism in developed economies (ibid.: 361–363). We will discuss these below, when venturing into the normative implications of GD more general.

3.4 The Continuity hypothesis

In rejecting not only the specific understanding of retention (as "replication"), but the whole notion that socio-economic evolution follows "Darwinian" principles, the *Continuity Hypothesis* (henceforth CH) is even farther removed from HKGD than Pelikan's modified variant of GD. CH emphasizes that processes of "evolution" in nature and culture differ too much to allow for the application of a specific common ontological structure as that suggested

[49]Recursive application is possible: B-Agents at one level can also play the part of C-agents at another level (and vice versa, see ibid.: 352)

[50]This term is used in a broad sense, including not only specific prescriptions, but also general negative "institutional rules" (ibid.: 346). In general, instructions can operate at the genetic, "cultural", "organizational" or "national" level (ibid.: 357). All uses of instructions require pre-existing instructions, which implies that for each agent, the developmental potential of its actual instructions is ultimately constrained by its initial (genetically hard-wired) instructions. The possibilities of evolution in general are also limited by this set of initial instructions (ibid.: 349-350).

by HKGD.[51] On this basis, it goes on to specify exactly in which limited sense Darwinian theory is indeed relevant for understanding economic behavior and change. Specifically, from this point of view Darwinian evolution is only able to explain the origins of the human cognitive capacities on which socio-economic evolution builds. The ontology CH offers turns out to be richer and more nuanced than HKGD's (Vromen 2008: 15).

Beyond the fundamental assumption of ontological monism and the causal interconnectedness of natural and cultural evolution (which they share), advocates of CH reject the basic methodological approach pursued by HKGD, viz., to first set up highly abstract principles, which are then, in a top-down fashion, mechanically applied to specific cases (Buenstorf 2006). Ironically, Darwin himself worked in a much more inductive, empirically oriented way (Levit et al. 2011). As to ontological commonalities, proponents of CH claim that evolution in both the biological and the cultural realm can be characterized as involving the emergence and dissemination of *novelty*. This is taken to be the only common property of evolutionary processes in different domains of reality. Hence, it is an ontological claim that directly challenges HKGD's particular ontology. CH's specification of the ontology of evolutionary processes then gives rise to a generic concept of "evolution" as the "self-transformation over time of a system under investigation" (Witt 2002: 9). The basic elements of this self-transformation are argued to be the "endogenous creation of novelty and its contingent dissemination" (Witt 2008b). The "genuinely evolutionary feature" of institutions, technologies, language, the law, scientific theories or any set of ideas is "that they are capable of transforming themselves endogenously over time", i.e., that they are able to create novelty (ibid.). Thus, it is the *endogeneity* of change that is seen as the feature of evolutionary processes that the economist should focus upon.[52]

CH postulates a linkage between biological and cultural evolution that is much more specific than anything HKGD has to offer on this subject. Ongoing processes of socio-economic change are argued to be weakly, but persistently influenced by the products of antecedent genetic evolution (Witt 1999); due to the comparatively slow pace of genetic evolution, the latter are assumed to be "given" for the purposes of economic theorizing. The two processes meet, that is, particularly in those parts of the human genetic endowment that give rise to culturally significant behavior. As Witt (2008b: 550) puts it, "[t]he mechanisms by which the species have evolved in nature under natural selection pressure, and are still evolving, have shaped the ground for, and still influence the constraints of, man-made, cultural forms of evolution, including the evolution of the human economy." This does, however, not imply that there is any similarity between these two processes: "[T]he mechanisms of

[51] As Pelikan (2011) points out, his version of GD shares with CH the view that socioeconomic evolution is a continuation of the biological one (a position shared also by HKGD) and "that it is indeed not Darwinian in the sense of HKGD" (Pelikan 2011: 342).

[52] This is of course inspired by Schumpeter's approach to Evolutionary Economics.

man-made evolution that have emerged on that ground differ substantially from those of natural selection and descent." (ibid.) In particular, the former appear to be much more complex than the latter.What distinguishes cultural evolution from biological evolution is exactly the role played by human creativity, intentionality, social learning and the capacity to imitate in an insightful way.[53]

Hence, CH delimits the very range of explananda where Darwinian theories can suitably be applied. In this sense it is more general than HKGD. The explanatory capacity of theories of "natural selection" appears to be limited: They are able to explain the "natural origins of, for example, human learning, intentionality and deliberative behavior, but they are ill-suited to grasp the dynamics of cultural evolution that is based on these evolved capabilities" (Cordes 2006: 539).[54] We argue that one part of these "dynamics of cultural evolution" consists in people deliberating about the normative basis, conditions and instruments of *policy* intervention into the ongoing process of economic evolution. Hence, HKGD's gaps are highly relevant when it comes to developing an evolutionary account of policy-making. This is the topic of the next section.

4 Policy and welfare in an evolving economy

Evolutionary economists are increasingly interested in developing policy implications. Policy implications depend in important ways on the manner in which we perceive, frame and interpret statements about facts (for example, facts about human nature).[55] While research on the normative implications of evolutionary change is still in its infancy (Nelson and Winter 1982: ch. 15; Witt 2003b; Schubert 2012, 2013a), there is an emerging consensus that, due to their static character, concepts from standard (Paretian) welfare economics are

[53]The way genetically programmed basic wants, dispositions and mechanisms of non-cognitive learning continue to shape economic behavior has been explored in several studies that apply the CH framework without, of course, resorting to any notion of variation, selection, or replication (see Witt 2001, 2004; Buenstorf 2006; Cordes et al. 2008; Wörsdorfer 2009). These theories examine, e.g., the question how individuals acquire new idiosyncratic wants on the basis of (universally shared) basic needs, why new goods and services are continuously consumed although basic wants are mostly satiable, or to understand historical changes in patterns of production or firm organization.

[54]See also Witt and Cordes (2007: 321).

[55]This is self-evident as regards instrumental policy statements, where some goal is externally given, and the economist-advisor looks for the most appropriate policy tools to achieve that goal. It also, however, applies to genuinely normative theorizing in the sense of Keynes (1917), where the plausibility of alternative policy goals or criteria itself is analyzed. Statements of this latter kind depend on facts in an *indirect* way. For instance, if we assume the economy to be a closed stationary system, the criterion of Pareto optimality looks much more attractive than in the case of an open, dynamic system.

ill-suited to deal with the issues involved. It is also widely agreed that insights into the biological and psychological background of human attitudes and values can usefully inform and improve policy advice—the difficult issue being what exactly is meant here by "informing".

4.1 Some preliminaries

While it is trivially true that, given the open-ended character of evolution "the outcomes of a selection process are necessarily neither moral nor just" (Hodgson and Knudsen 2006a: 6) and may even lead to "systematic errors" (Hodgson and Knudsen 2008b: 57), we also know that the meaning of normative notions such as "moral" and "just" is itself the product of some anterior set of evolutionary processes. This is uncontroversial. It is, however, a non-sequitur to immediately jump to the conclusion that these processes ought to be specifically modeled as involving some kind of "natural selection" along the lines of HKGD. As we will argue in this section, such a move may tempt the researcher into thinking that notions such as "moral" and "just" should be interpreted as reflecting some understanding of "fitness" or "adaptive value". Such analogies are highly misleading. We argue that it is ultimately the *top-down* character of the methodological approach suggested by HKGD that makes it likely that normative implications are developed in a misguided way. As neither Pelikan's variant of GD nor the CH approach suffer from this shortcoming, they are less susceptible to mislead the development of policy implications.

Let us be clear at the outset that some regions of the space of conceivable policy implications are excluded by the evolutionary character of economic change:

1. First and foremost, it does not make sense to ascribe any kind of overall purpose ("telos") to the evolutionary process *per se*. Closely related to that, it is a non-sequitur to postulate (or to imply) that evolutionary processes per se somehow necessarily generate "optimum" results. As Metcalfe (2001: 565) rightly points out, "one important consequence of the Darwinian theory was to banish the idea of perfection from the discussion of progress". As a consequence, "no means or outcome should be denied moral evaluation" (Hodgson 1999: 241).
2. Second, given the difficult epistemic conditions reigning in an evolving economy, policy-makers cannot hope to predict precisely how the strategies they implement will affect people's behavior and aggregate outcomes. The most they can do is to experimentally modify existing institutional arrangements with a view towards altering *patterns* of outcomes (Vanberg 2006).
3. Third, policy implications should at least not be completely detached from the realm of individuals' concerns, i.e., their "quality of life" or "well-being", however broadly understood. A set of decidedly *non*-individualist

policy implications would run into difficulties of legitimization and of practical implementation (see below).[56]

Ultimately, our discussion boils down to the question whether any variant of GD can lend theoretical substance to and improve our understanding of the truly "evolutionary", centuries-old (political) problem-solving method known as trial-and-error (e.g. Harford 2011). This is due to the non-teleological nature of evolutionary processes (point 1) and to their epistemic conditions (point 2). Note that the criteria to identify the "errors" should at least partly be based on notions of individual well-being (point 3).

In the following, we will show that future policy applications of HKGD will likely fail to do this job, for the following reasons:

1. The assumption of a fundamental homology between natural and cultural evolution runs the risk of leading scholars to either stress, in a one-sided way, the supra-individual ("systemic") level of welfare to the detriment of the level of individual well-being,
2. or to conflate biologically determined and culturally shaped norms and values, thereby seriously distorting policy advice.

In other words, the quality of normative reasoning (a precondition of developing sound policy advice) suffers. By "distort" we do emphatically not imply that any variant of GD somehow systematically tends to support one ("liberal" or "conservative" or whatever) political doctrine over others. Let us also be clear that our argument is totally unrelated to the century-old history of charges leveled against the so-called "Social Darwinism" approach.[57]

We first specify the kind of misdirection that can be expected from a normative approach following HKGD. We then illustrate this risk by dwelling on Hayek's late, most explicitly "evolutionary" work, as well as a recent attempt, explicitly grounded in a natural selection framework, to develop an evolutionary criterion of societal "progress" (Cochrane and Maclaurin 2012). Subsequently, we show more specifically how an approach to policy-making framed by HKGD and marred by the biases described above may lead practical policy advice astray (or rather prejudge its results). We conclude this section

[56]This does obviously not imply any call for endorsing, as a matter of normative metric, the specific kind of individualism that assumes, à la Bentham, that the individual is (always or typically) the best judge of her own well-being. This position is rightly rejected by Hodgson (1999: 244–245). In what follows, the term "individualist" is used in the sense that it denotes policy advice that is based on a welfare criterion which in turn connects at least partly to the well-being of individual agents who may very well be non-atomist (by virtue of interacting strategically, say).

[57]As Hodgson (2004b) demonstrates, historically, the semantics of the much-abused term "Social Darwinism" have been too volatile for it to be useful. The most contradictory implications have been "derived" from Darwinism over the decades, typically just reflecting the norms and prejudices of the times (see also Ruse 2006: 204–207). On Darwin's own stance towards social Darwinism see Ruse (1999: 264–265).

by showing that Pelikan's variant of GD does not suffer from the same biases. Moreover, it is ironic that neither does Hodgson's own normative vision of "Evotopia", having been elaborated *free from any explicit reference to GD* in Hodgson (1999).

In order to have a criterion to identify what it means for normative implications to be "led astray", we emphasize the importance of point (3), above: Let us postulate that any normative implications should be of practical relevance in a broadly democratic setting. Hence, people have to be *convinced* by them. Normative economists have to demonstrate that their implications lead to practical advice that, ultimately, connects to what real-world individuals care about.[58]

4.2 The pitfalls of the Darwinian view of "progress"

When Darwin speculated about evolutionary "progress", he stressed the characteristics (the "endless forms most beautiful and most wonderful") of species, leading to the development of higher mammals and, ultimately, to man.[59] Put differently, he focused on "what we *are*, rather than on what we can *do* or *be*" (Sen 1993: 124, italics added). An alternative and probably more convincing (to the people involved) concept of human progress would argue in terms of man's actual quality of life.

As Sen (1993) shows, this Darwinian shift in emphasis has far-reaching implications for the likely focus of scientists' normative reasoning. In particular, the Darwinian view lends itself easily to narrowly focus on adapting the *species* itself, given its environment and the associated selective pressures, rather than the (socio-cultural or institutional) environment in which the species live. Even if the focus is on the rules and practices that constitute the individuals' environment (as in the case of Hayek's evolutionary account of group selection), political options to *purposefully* adapt the environment instead—in order to promote people's quality of life—may be downplayed. Apart from this risk in misdirecting the research focus, there is of course the risk of falling prey to misleading analogies: If progress is to be judged by the excellence of the species produced, it is tempting to define "excellence" by pure reproductive success. After all, this is what "fitness" is about in the biological sphere.

[58] A normative perspective broadly in line with individualism is perfectly compatible with an evolutionary world-view, as demonstrated, e.g., by Kitcher (2012): "[ethical] changes come about ... through the discovery of natural facts, about people, their capacities, sufferings, and aspirations, on the basis of which there are new possibilities for mutual engagement." Assuming that "mutual engagement" here is meant to include "mutual advantage" we have a case for the biological underpinning of individualist morality, linked to the propensity to cooperate.

[59] On Darwin's personal commitment to, and scientific concept of progress see Ruse (2009).

Although the terms "fitness" as well as "adaptive complexity" have a latent normative connotation,[60] the analogy to what is "valuable" or "desirable" in modern human society is fundamentally mistaken. There is no clear relationship between reproductive success or even "survival" to the actual quality of life or well-being of human beings: "We recognize many virtues and achievements that do not help survival but that we have reason to value; and on the other side, there are many correlates of successful survival that we find deeply objectionable" (Sen 1993: 130–131).[61]

Thus, we have reason to expect research in the HKGD framework that is concerned with deriving policy implications from evolutionary theory to display a one-sided focus on the quality of supra-individual entities ("the human species") or processes ("the market system"), and/or to fall into the trap of conflating purely biological criteria of success with culturally formed criteria of welfare. Let us stress again that our concern is with the *quality of normative reasoning*: A lot of important questions may not be asked due to the fact that the conceptual framework itself induces its users to turn a blind eye toward them. Let us now illustrate this risk.

4.3 Hayek and "Darwinian" policy advice

Hayek is often cited as one of the early proponents of a "Darwinian" viewpoint in economics, a representative of GD *avant la lettre* (Marciano 2009; Whitman 1998: 46–47), despite the fact that he certainly failed to appreciate the originality and significance of Darwin's concept of natural selection (Hodgson 2004a). His positions on the normative (or welfare) implications of an evolutionary world-view have oscillated over the years (Kerstenetzky 2000; Vanberg 1994a; Sugden 1993). Throughout his work, there is a tension, ultimately unresolved, between an "evolutionist" attitude—claiming that socio-cultural evolution eventually brings about "group efficiency" and "adaptedness"—and the evolutionary view proper (more in line with Hayek's general methodological-epistemic convictions), according to which evolutionary processes are open-ended and unpredictable. While the former position necessarily translates into some sort of Panglossian passivism, the latter opens up the space for a constructive reasoning and deliberation about normative criteria to judge "progress" and, hence, to the critical scrutiny of existing institutions and policies.

Within this perspective, though, Hayek again draws contradictory normative implications: On the one hand, he typically argues that the "common

[60] Ghiselin (1995) suggests interpreting "fitness" as the increase in "useful technological innovation", without however daring to explicitly equate "useful" with "good" in any sense (ibid.: 1036).

[61] To illustrate the first part of the statement, modern happiness research shows that the tendency to accumulate consumer goods with strong extrinsic attributes, while certainly explainable by an urge to increase and display "fitness", at the same time decreases subjective well-being, a much more important goal in life (Ng 2006).

good" should ultimately be conceived, in quasi-contractarian terms, as the "facilitation of the pursuit of unknown individual purposes" (Hayek 1976: 1).[62] In his later, explicitly "evolutionary" writings, however, he switches to supra-individual criteria, obviously borrowed from evolutionary biology—such as "population size"—, arguing that given the way impersonal processes of socio-economic evolution work, it is meaningless to ask whether the individuals affected by them would ever agree to the results, since "in any case, our desires and wishes are largely irrelevant" (Hayek 1988: 134).[63]

Positions such as these can be read as reflecting a notion of welfare that is completely detached from the level of individual benefits. This illustrates the point we have made in the preceding section: Framing one's theoretical analysis in terms of the Darwinian paradigm may lead the researcher into conceiving "welfare" as pertaining to supra-individual phenomena rather than the actual quality of life of individuals. Put differently, it introduces a kind of "system bias" into the analysis. A pure system-based view of progress would be problematic on substantive grounds (see point 3, above). More importantly, it is also problematic on grounds of methodology: Instead of carefully arguing his case, Hayek seems to regard his "evolutionary" notion of progress as self-evident; it is, as it were, smuggled in more or less subconsciously, due to the particular metaphorical and theoretical framing of the analysis.

The risk of slipping into analogical thinking becomes apparent at this point: Success criteria that were perfectly valid for life in early human hunter-gatherer contexts (such as "population size") cannot be translated into welfare notions in the context of modern society. They cannot substitute for man's critical and creative task to devise, on his own and by using his intellectual and creative capacities (that are, to be sure, a product of anterior processes of evolution) and in discussion with his peers, ethical criteria. From an evolutionary perspective, the process of discussion should of course be informed by insights into the origins and development of, e.g., systems of morals. This refers specifically to man's general capacity for ethical behavior (which is most probably a product of biological evolution; see Ayala 2010). But beyond that, man is free to imagine, to try out and to apply any feasible and generally agreeable moral codes and ethical systems: "Our genetic heritage gives us a biological base on which to build our values, but a base is only a base" (Dennett 1997: 67). Once the base was established, cultural evolution set in, following its own peculiar dynamics. This fundamental insight is somehow glossed over by the repeated insistence of HKGD's advocates that "the human doing the ["artificial"] selection is also a product of natural evolution" (Hodgson and Knudsen 2006a: 11), that her "preferences and choices" have to be explained

[62] See Sugden (1993) and the references given by Vanberg (1994b: 465–466).

[63] See also (ibid.: 133): "[A]s with every organism, the main 'purpose' to which man's physical make-up as well as his traditions are adapted is to produce other human beings ... There is no real point in asking whether those of his actions which do so contribute are really 'good', particularly if thus it is intended to inquire whether we *like* the results." (italics in the original). On this tension in Hayek's normative argument, see also Vanberg (1994a: 183) and Gray (1998).

(ibid.), and that "[i]nsofar as organisms are purposeful, this capacity too has evolved through natural selection" (ibid.: 13).

A crucial step is neglected by framing research tasks in this way, namely, the transition between genuinely biological and cultural evolution. The undisputed fact that human preferences and values are, at least in a basic sense, the product of biological evolution does allow one to conclude that in order to be sustainable, modern systems of morality must be, by and large, compatible with human nature. It does, however, *not* allow one to conclude that ethical precepts, even fairly universal ones, reflect biological fitness (Ayala 2010: 9020–9021). Rather, natural selection has endowed humans with the unique capacity to overcome (partly, at least) the original constraints posed by natural selective pressure. This insight is emphasized by CH, but rather sidestepped by HKGD.

4.4 Cochrane & Maclaurin on "evolutionary progress"

We now turn to a more recent attempt to develop a normative notion of "progress", to be used in the field of evolutionary economics, that is directly derived from evolutionary biology. Cochrane and Maclaurin (2012) suggest that progress should be conceived as being constituted by an increase in a system's "evolvability" over time, a concept which they define as "the rate at which a system can adapt to changes in its environment" (ibid.: 101–102).[64] Note that the *system* is perceived as the evaluandum, rather than the individual states of human agents (such as their degree of preference satisfaction, their capabilities, happiness or wealth). The authors are obviously committed to conceptualizing evolutionary processes in terms of HKGD. Referring to Hodgson (2002), they claim to "believe that evolution in economic systems is evolution by natural selection" (ibid.: 102).

As we would expect, the normative criterion that they propose is, again, completely detached from the level of individual well-being, as they concede themselves (ibid.: 108). As they put it, "[i]ncreases in the evolvability of an economy ... are unlikely to benefit all stakeholders at all times" (ibid.: 109). In their view, linking "progress" to the preferences of actual individuals amounts to "psychologizing" the term (ibid.). They then suggest that "progress" may operate differently at different levels of the economy. "Progress" in the sense of evolvability, though, is not "necessarily desired by, or beneficial for, all individuals that interact in societies at the economic level" (ibid.). Bluntly, they "reject using the desires of economic actors to measure evolutionary economic progress" (ibid.: 110). No reasons are provided for this rather radical (and certainly counterintuitive) step. Instead, some remarks are offered on the importance of separating the "psychological question" from the issue of whether there is any kind of progressive directionality in evolutionary change.

[64]The definition that they give in FN 4 (ibid.: 4) is slightly more specific. There, they characterize evolvability as "the rate at which a characteristic will respond to selection pressure". The following section is partly based on Schubert (2013b).

Hence, there seems to be a serious risk for normative accounts following the footsteps of HKGD to develop biased welfare implications. First, arguing in terms of the HKGD framework leads scientists to perceive normative issues in a way that focuses on the qualities of the whole system, rather than on the quality of life (or well-being) of actual human agents. Second, the HKGD framework appears to increase the risk that biological and socio-cultural notions of welfare (or success or progress, if you will) are conflated. In both cases, what we describe seems to happen without full awareness on the part of the authors, as evidenced by the lack of serious attempts to justify the shift in perspective.

4.5 Some practical issues: innovation policy and status races

An example of potentially misguided policy advice that is highly relevant for evolutionary economists has been uncovered by Nooteboom (2008) in the context of innovation policy. According to him, the "intellectual contagion from biological evolution" with the corresponding adoption of the "variation" metaphor leads evolutionary economists to tacitly assume that invention and idea creation are "blind" or "random", and hence do not admit of systematic explanation. As Nooteboom clarifies, though, "while invention is subject to much trial and error and remains unpredictable, it is not blind, but is based on experiential learning that employs a certain type of inference from failures and indications for the potential of new directions" (ibid.: 97). Adopting the HKGD framework may lead economists to overlook this kind of inferences.

More generally, it may run the risk of narrowing the analytical focus on processes of application, innovation, and diffusion ("exploitation" in Nooteboom's parlance), while neglecting the sources and processes of *invention* (or "exploration", ibid.: 79–80). Since the former can relatively easily also be explained by a neoclassical rational choice approach, it may be tempting to the scientific observer to fall back into the view that innovation can somehow be "rationally" planned. As Nooteboom stresses, though, "market mechanisms or planning that are appropriate for the promotion of *application* may have an adverse effect on *idea creation*" (ibid.: 80, italics added). Effects such as this are likely to be glossed over by a one-sided focus on adaptation/innovation. The development of sound policy advice with respect to the promotion of technological or commercial novelty may, thus, be negatively affected by adopting the HKGD framework.

Let us turn to a policy discussion that has spurred some controversy in recent years. Given that people apparently have a tendency to spend a significant part of their income and wealth on "positional" or "status" goods, despite the fact (often known to them) that the corresponding gains in well-being are—almost by definition—of a transient nature only, some scholars have suggested to tax either income or the consumption of such goods directly (e.g. Frank 2008). Here again, the policy advice, while seemingly following the standard economic textbook (provided one buys the characterization of status consumption as generating "externalities"), may be misguided, for the underlying

normative reasoning is incomplete at best, and biased at worst. Being narrowly focused on biological drives and instincts that promote status-seeking consumption and the ensuing "status races", it overlooks the manifold ways in which cultural rules factually and potentially mitigate this behavioral tendency in a productive way. Put differently, the critical juncture between biological and cultural evolution is neglected. To illustrate, people have learned to escape the deadlock of status races by creatively inventing novel dimensions in which to strive for distinction (Wilkinson 2006; Frey 2008: 171–172). Policy can try to redirect people's efforts to activities that generate less harmful side-effects in terms of, say, environmental resource use (Ahuvia 2008; see also Cordes and Schubert 2013).

4.6 Pelikan's GD and the trial-and-error method of institutional reform

As we have seen in Section 3.3, above, the variant of GD proposed by Pelikan differs from HKGD in some essential points. Interestingly, Pelikan has developed his approach in an inductive way, building on insights gained through the study of practical policy issues such as the institutional transformation of formerly socialist economies (see, e.g. Pelikan 1995). Since he carefully avoids interpreting retention narrowly as "replication"—thereby allowing economically relevant *instructions* (such as institutional rules) to be preserved, stored or memorized in a variety of ways—his approach lends itself much more easily to policy applications than HKGD.

Three aspects of his version of GD deserve particular emphasis in the context of the present discussion. First, the shift in emphasis toward the *content* of what is retained, i.e. to the instructions themselves (the book, rather than the copying machine, as he puts it in Pelikan 2012), directs attention toward the fundamental importance of the substance of institutional rules in the development of economies. For instance, Pelikan (2011: 361–363) stresses the "agent-quality effects" (i.e. the impact of institutional rules on the agents' cognitive abilities, preferences, values, etc.) and the inherent limitations stemming from the individuals' "cultural-genomic" instructions. This leads him to warn policy-makers that unfettered immigration from foreign cultures may, by importing "memes" that are partly economically dysfunctional (rather than merely "ornamental") in fact undermine economic development. For instance, such memes may include practices concerning agents' propensity to be corrupt, trustworthy, or to engage in violent behavior.

Second, by offering a clear microfoundation (a model in which b-agents self-organize into complex C-agents), and by balancing the demands of "adaptive" efficiency, with its focus on the viability of systems, against those of allocative efficiency,[65] his approach is likely to avoid the "system bias" referred to by Sen (see above). Third, Pelikan is careful in paying attention to the critical juncture between biological and cultural evolution, something that is underdeveloped

[65] See Pelikan (1995: 188–189) and Pelikan (2003: 29–30).

in HKGD, as we have seen. His approach is thus likely to avoid the trap of conflating biological and cultural values or norms (i.e. the trap Hayek fell into).

4.7 Hodgson's "Evotopia" approach to normative reasoning

Geoffrey Hodgson himself seems to be aware of the risk implied by drawing crude analogies between biological and socio-cultural criteria of success or welfare. He concedes, for instance, that the notion of "survival of the fittest"—often wrongly attributed to Darwin—, when uncritically translated into a policy criterion, seems to imply the "rejection of any kind of state meddling, subsidy or intervention, and the support of laissez-faire" (Hodgson 1993: 25). Again, we would argue that the problematic part here is not the specific ideological position that is allegedly supported, let alone justified in this way, but rather the inadequate methodology behind it: A (presumed) notion of biological success is literally translated into the sphere of human affairs, without further scrutiny.

Hodgson's own contribution to normative evolutionary economics, outlined in Chapter 11 of Hodgson (1999), manages to avoid the pitfalls described in this section.[66] At first sight, this might undermine our argument that HKGD risks misleading evolutionary policy advice. However, what stands out in Hodgson's approach is the *lack* of any explicit grounding in HKGD. Hodgson's key premise is that "diversity and variety" have an "essential, dynamic function" in evolutionary processes. Malthus, Mill and, of course, Darwin are cited as precursors of this concept. Accordingly, "evotopia", his normative benchmark, is defined as a "system that can foster learning, enhance human capacities, systematically incorporate growing knowledge and adapt to changing circumstances" (ibid.: 240). Its "first principle" is argued to be "the necessity of variety" (ibid.: 246). Already in Hodgson (1993: 399) he had asserted that "[t]he adoption of the Darwinian evolutionary metaphor illuminates the need for renewable variety in evolving economic systems." Practical policy implications seem to be straightforward: the goal of economic activity is taken to be "to safeguard and develop human capabilities ... the production of useful and warranted knowledge ... knowledge that serves human needs, enhances the human life process and helps humanity adapt to, and live in harmony with, its natural environment" (Hodgson 1999: 247). Thus, the notorious "system bias" of evolutionary policy advice is carefully avoided.

While it is uncontroversial that the Darwinian evolutionary metaphor "illuminates" the significance of variety, the "Darwinian triple" as understood by HKGD seems not to be necessary to develop this insight. No evolutionary economist would deny that variety and learning are the hallmark of evolutionary policy advice. On the other hand, adopting HKGD raises additional

[66] His approach is problematic for other reasons. For instance, important concepts in normative economic reasoning, such as "exchange" or "mutual advantage", are neglected altogether.

issues: Why focus on "variation" alone? It seems counterintuitive to argue that maximizing variety is, by itself, a desirable societal goal. Other metaphors don't fare better: For instance, a one-sided focus emphasis on "selection" would appear to bias economists in favor of proposing libertarian policies, while overplaying the role of "replication" might lead to conservative policy advice.[67] HKGD seems unsuited to provide reasons for the choice of one of these "Darwinian" principles: Normative reasoning would end up being based on arbitrary foundations.

5 Conclusions

Can some generalization of "Darwinian" principles assist the development of evolutionary policy advice? As we have seen, the answer depends on which specific variant of GD one has in mind.

The variant advanced by Hodgson & Knudsen (HKGD) suffers from several shortcomings when it comes to formulating the normative implications of evolutionary insights. As Buenstorf (2006: 515) puts it, adhering to the framework suggested by HKGD may in general "induce researchers to adopt a concept because of its correspondence to the Darwinist framework rather than its inherent usefulness, and potentially detracts attention from relevant aspects of the issue at hand". Apparently, this risk not only pervades positive theorizing, but also the attempts to develop normative implications on the basis of a HKGD-inspired theoretical perspective. As this paper has attempted to demonstrate, HKGD may indeed, by acting as a focusing device, lead scientists astray in their search for normative criteria and policy goals that are both compatible with an evolutionary world-view and plausible (or defendable) in their own right. It may induce them to construct, if implicitly, analogies between biological criteria of success or "fitness" and cultural concepts of welfare, and lead them to narrowly focus on the systemic "quality-of-species", rather than the individual quality-of-life level of welfare.

The paper has illustrated these dangers by discussing a variety of cases from the literature, where an explicit or implicit endorsement of a HKGD perspective has resulted in misguided metrics of people's welfare. By "misguided" we emphatically neither mean a specific ideological position[68] nor an endorsement of something akin to "Social Darwinism", but rather low-quality reasoning at the more fundamental level of "normative structure" (Nelson 1977). The intricate task of defending normative criteria is left to the simple declaration of analogies to biological evolution. Such analogies may be especially mistaken in the realm of normative theorizing, since the key

[67] Hodgson himself has ventured into this direction, in the context of developing business policy advice, referring to Hodgson and Knudsen (2010b). See University of Hertfordshire (2010).

[68] We are agnostic as to ideological implications of a "Darwinian" viewpoint, except as to the rejection of an utterly non-individualistic perspective on welfare. See Section 4.1, above.

normative notion—"progress"—is particularly problematic in biology (Ruse 1996; Ghiselin 1995).

One may object at this point that the cases discussed reflect, not an adherence to HKGD properly understood, but rather instances of "reckless overgeneralization" (Hodgson and Knudsen 2010a: 2). This may, for instance, apply to Hayek's case, discussed above. This objection, though, does not invalidate the misgivings about orienting normative analysis toward a HKGD framework. A conceptual framework that is prone to be (mis-)used with such far-ranging effects is itself hard to defend.

We submit that the source of the problem is threefold. First, by insisting on the role of "replicators", Hodgson & Knudsen leave the door wide open for misleading biological analogies to enter economic theorizing. In contrast, Pelikan's GD uses the much more general notion of "retention", arguing that together with variation and selection, retention applies to all human searching for new knowledge. Second, in its fundamental ontological presuppositions, HKGD does not clearly mark the difference and the transition between biological and cultural evolution. In contrast, both the alternative variant proposed by Pelikan and the CH are explicit about the critical juncture between the two levels, thus offering a richer ontology (Vromen 2008). Third, what HKGD offers is essentially a deductive, *top-down* methodology (Levit et al. 2011). Scientists may feel compelled to look at economic phenomena through the analytical lens provided by the "Darwinian triple", and to bend their theoretical concepts so that they fit into the scheme. As we have seen, neither Pelikan's variant of GD nor the CH suffer from this shortcoming, as both are based on inductive reasoning.

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